



United States  
Environmental Protection  
Agency

EPA530-R-07-001  
April 2007

## **National Priority Chemicals Trends Report (2000-2004)**

### **Section 4**

#### **Chemical Specific Trends Analyses for Priority Chemicals (2000–2004): Dioxin and Dioxin–Like Compounds (Dioxin)**

Hazardous Waste Minimization and Management Division  
Office of Solid Waste  
U.S. Environmental Protection Agency

#### **Contact Information:**

Bill Kline, Senior Data Analyst  
Analysis & Information Branch  
(540) 341-3631  
kline.bill@epa.gov

Tammie Owen, Data Analyst  
Analysis & Information Branch  
(703) 308-4044  
owen.tammie@epa.gov

Ben Lesser, Chief  
Analysis & Information Branch  
(703) 308-0314  
lesser.ben@epa.gov

## Dioxin and Dioxin-Like Compounds (Dioxin)

### Chemical Information:

Dioxin refers to a group of chemical compounds that share similar chemical and biological properties. Several hundred of these compounds exist and are members of two closely related families: chlorinated dibenzo-*p*-dioxins (CDDs) and chlorinated dibenzofurans (CDFs).

**General Uses** – CDDs and CDFs are not commercially produced except in small quantities for chemical analyses and toxicological research. CDDs and CDFs are formed as unwanted byproducts when chlorinated materials are involved in combustion or other high-temperature processes, such as waste incineration, energy generation, metallurgical processes, chemical manufacturing and other industrial processes. Energy generation sources of CDD/CDF releases include the combustion of coal, oil, and wood. Other high-temperature sources include Portland cement production, pulp mills using the kraft process, asphalt mixing plants, catalyst regeneration at petroleum refineries, and carbon reactivation furnaces. Metallurgical processes that may release CDD/CDFs include ferrous sources such as iron ore sintering, coke production, and the production of steel in electric arc furnaces from scrap feed. Secondary aluminum, copper, and lead smelters can also be sources of CDD/CDFs. CDDs and CDFs can also be formed as unintended byproducts of manufacturing processes. For example, they are generated in pulp and paper mills during chlorine bleaching.

**Potential Hazards** – Dioxins can cause a number of health effects. The most well known member of the dioxins/furans family is 2,3,7,8 TCDD which is a known human carcinogen (National Toxicology Program). Also, high doses of dioxin can cause a skin disease called chloracne.

### Introduction:

Dioxins are of particular concern to EPA because they are:

Persistent: they break down very slowly and remain in the environment for many years after release,

Bioaccumulative: they are retained in fatty tissues and biomagnify within the food web (i.e., they increase in concentration as they progress up the food chain) and serve as a source of exposure to sensitive organisms; and

Toxic: they cause a variety of long-term adverse health effects, including chloracne, immunotoxicity, developmental and reproductive effects, and cancer.

Dioxins are generally produced and released by industrial processes in relatively small amounts compared with amounts of other TRI-listed chemicals produced and released. Because of this, and the fact that certain dioxins are toxic at very low levels of exposure, a much lower TRI reporting threshold was established for dioxins (0.1 gram per year). As such, facilities report dioxins to TRI in grams. For the purposes of this section, we present our trends analyses using grams, rounded to the nearest whole gram. Please note that most of the dioxin quantities in the database are expressed in terms of very small quantities – even up to seven decimal places. In rounding the quantities to the nearest whole gram, certain quantities will appear to be zero. We made this conversion to facilitate our trends analyses. In no way should this conversion be interpreted as minimizing the importance of smaller quantities of dioxin – which are of considerable concern.

Elsewhere in this document, where analyses of trends for aggregated quantities of PCs are presented, we converted the quantities (grams) of dioxin to pounds (using 454.5 grams/pound) and rounded these quantities to the nearest whole pound. We made this conversion to provide uniformity and consistency in the quantities used

to perform analyses of trends at the more aggregated levels. Again, in no way should this conversion and rounding be interpreted as minimizing the potential health affects associated with smaller quantities of dioxin.

### **Summary Analysis:**

- **NATIONAL** – In 2004, approximately 220,000 grams of dioxins were reported by 378 facilities. This was a 24 percent decrease compared to the quantity reported in 2000 and a 30 percent decrease from the quantity reported in 2003.
- **REGIONAL** – In 2004, facilities in Regions 4, 5, and 6 reported 97 percent of the dioxins; Region 6 facilities alone reported approximately 61 percent of the total quantity.
- **STATES** – In 2004, 93 percent of the dioxins were reported by facilities in five states (Louisiana, Texas, Mississippi, Michigan, and South Carolina); facilities in Louisiana reported approximately 41 percent of the total quantity.
- **FACILITIES** – Of the 378 facilities that reported dioxins in 2004, seven facilities accounted for 89 percent of the total quantity of this chemical; 18 facilities accounted for 96 percent.
- **MANAGEMENT** – From 2000 to 2004, dioxins were managed primarily by treatment. In 2004, treatment was used to manage 77 percent of the dioxin quantity, followed by disposal (17 percent) and energy recovery (6 percent).
- **INDUSTRY SECTOR** – Facilities in 39 industry sectors reported dioxins in 2004. However, facilities in only three of the industry sectors (SIC-2869-Industrial organic chemicals, SIC 2491-Wood preserving, and SIC 2812-Alkalies and chlorine) reported approximately 94 percent of the total quantity of dioxins in 2004. Facilities in SIC 2869 (Industrial organic chemicals, nec) reported approximately 55 percent of the total quantity; this was a significant increase from the quantities reported in 2000, as well as in 2003.

### **National Trends:**

Exhibit 4.71 shows the number of facilities that reported dioxins in 2000 to 2004 and the quantities of this PC that were managed via disposal, treatment, energy recovery, and recycling. The number of facilities that reported dioxins since 2000 has been relatively constant, with an average of 372 facilities reporting each year. In 2004, approximately 220,000 grams of dioxins were reported. Compared to the quantity of dioxins reported in 2000, there was a 24 percent decrease in 2004. Compared to 2003, the quantity decreased by 30 percent from the quantity reported in 2003.

In 2003, the quantity of dioxins increased significantly, by approximately 27 percent, compared to the previous year. Much of this increase was due to the 138,000 grams of dioxins (contained in used telephone poles /wood wastes) reported by a wood preserving facility in Louisiana. This facility had reported much smaller quantities in previous years (2000–2002), as well as in 2004.

From 2000 to 2004, dioxins were managed primarily by treatment. In 2004, treatment was used to manage 77 percent of the dioxin quantity, followed by disposal (17 percent) and energy recovery (6 percent). Although EPA does not consider recycling to be a valid management method for dioxins, a very small amount of dioxin was reported as recycled.

**Exhibit 4.71. National Management Methods for Dioxin and Dioxin-Like Compounds, 2000–2004**

Management Methods for Dioxins and Number of Facilities	2000	2001	2002	2003	2004	Percent Change (2000–2004)	Management Method -- Percent of Quantity of This PC (2004)
Number of Facilities	379	367	362	374	378	-0.3%	-
Disposal Quantity (grams)	21,189	32,655	26,223	192,604	36,396	71.8%	16.6%
Energy Recovery Quantity (grams)	2,014	2,348	2,010	1,129	14,092	599.6%	6.4%
Treatment Quantity (grams)	267,023	285,000	217,857	119,936	169,175	-36.6%	77.0%
Priority Chemical Quantity (grams)	290,226	320,003	246,091	313,669	219,662	-24.3%	100%
Recycling Quantity (grams)*	4,469	1,433	1,429	30	29	-99.4%	-
*Note: EPA does not consider recycling to be a valid management method for dioxins; however, a very small amount of dioxin was reported to be recycled. Throughout this section, the recycled quantity is presented simply for consistency and completeness.							

Exhibit 4.72 shows the number of facilities that reported dioxins within various quantity ranges. Of the 378 facilities that reported dioxins in 2004, seven facilities accounted for 89 percent of the total quantity of this chemical; 18 facilities accounted for 96 percent. Although the overwhelming majority of facilities reported relatively small quantities of dioxins, it is important to remember that even very small quantities of this chemical are of concern as evidenced by the TRI reporting threshold of 0.1 grams.

**Exhibit 4.72. Size Distribution of Facilities that Reported Quantities for Dioxin and Dioxin-Like Compounds, 2004**

Dioxins (219,662 grams)		
Quantity (grams) Reported*	Number of Facilities Reporting This Quantity (2004)	Percent of Total Quantity of This PC (2004)
up to 0.1 gram	143	less than 0.1%
0.2 – 1.0 gram	88	less than 0.1%
1.1 – 10.0 grams	56	0.1%
10.1 – 100 grams	50	0.9%
100.1 – 1,000 grams	23	2.6%
1,000.1 – 10,000 grams	11	16.8%
10,000.1 – 100,000 grams	7	79.6%
* rounded to 1 decimal place		

## EPA Regional Trends:

Exhibits 4.73 and 4.74 show the quantity (grams) of dioxins reported by facilities within each EPA region between 2000 and 2004. In 2004, facilities in Regions 4, 5, and 6 reported 97 percent of the dioxins; Region 6 facilities alone reported approximately 61 percent of the total quantity. Facilities in Region 6 have consistently reported the largest quantity of dioxins since 2000. Compared to quantities of dioxin reported in 2000:

- Quantities in 2004 decreased in eight of the 10 EPA regions. In terms of quantities, facilities in Regions 2, 5, and 6 reported the largest decreases. In terms of percent decrease, facilities in Regions 1, 2, 9 and 10 reported at least a 50 percent decrease in 2004.
- Facilities in Regions 4 and 7 reported increased quantities of dioxins in 2004, compared to the quantities reported in 2000; large increases, compared to 2003 quantities, also were reported by facilities in these two regions.

Compared to quantities of dioxin reported in 2003:

- Facilities in Region 6 reported approximately 49 percent less quantity in 2004. A wood preserving facility in Louisiana accounted for most of this decrease.
- Facilities in Region 3 reported approximately 86 percent less quantity in 2004. Most of this decrease occurred at a facility in West Virginia. This facility attributed the decrease to the implementation of Maximum Achievable Control Technology (MACT) standards for its incinerator.
- Significant increases were reported by facilities in Regions 4 and 7. Most of the increase in Region 4 was due to how a wood preserving facility in Mississippi estimated the concentration of dioxins in its wastes. Most of the increase in Region 7 was reported by a wood preserving facility in Missouri; in 2004, this facility cleaned out sludge from a process wastewater treatment tank, resulting in approximately a five-fold increase in the reported quantity of dioxin.

**Exhibit 4.73. Regional Quantities (grams) of Dioxin and Dioxin-Like Compounds, 2000–2004**

<b>EPA Region</b>	<b>2000 (grams)</b>	<b>2001 (grams)</b>	<b>2002 (grams)</b>	<b>2003 (grams)</b>	<b>2004 (grams)</b>	<b>Percent Change in Quantity (2000–2004)</b>	<b>Percent of Total Quantity of This PC (2004)</b>
1	34	14	17	7	17	–50.6%	0.0%
2	12,788	1,272	110	107	124	–99.0%	0.1%
3	1,188	239	213	4,891	697	–41.4%	0.3%
4	16,940	14,416	14,197	12,810	49,457	191.9%	22.5%
5	51,969	65,473	19,112	29,786	28,770	–44.6%	13.1%
6	200,648	215,223	181,169	262,811	134,779	–32.8%	61.4%
7	329	400	798	1,106	3,741	1038.1%	1.7%
8	91	20,079	28,427	131	47	–48.0%	0.0%
9	1,745	503	627	581	445	–74.5%	0.2%
10	4,495	2,383	1,422	1,440	1,585	–64.7%	0.7%
<b>Total</b>	<b>290,226</b>	<b>320,003</b>	<b>246,091</b>	<b>313,669</b>	<b>219,662</b>	<b>–24.3%</b>	<b>100.0%</b>

**Exhibit 4.74. Distribution of Facilities Reporting Dioxin and Dioxin-Like Compounds in 2004 and the Quantities of Dioxin and Dioxin-Like Compounds Reported in 2004 by Region**

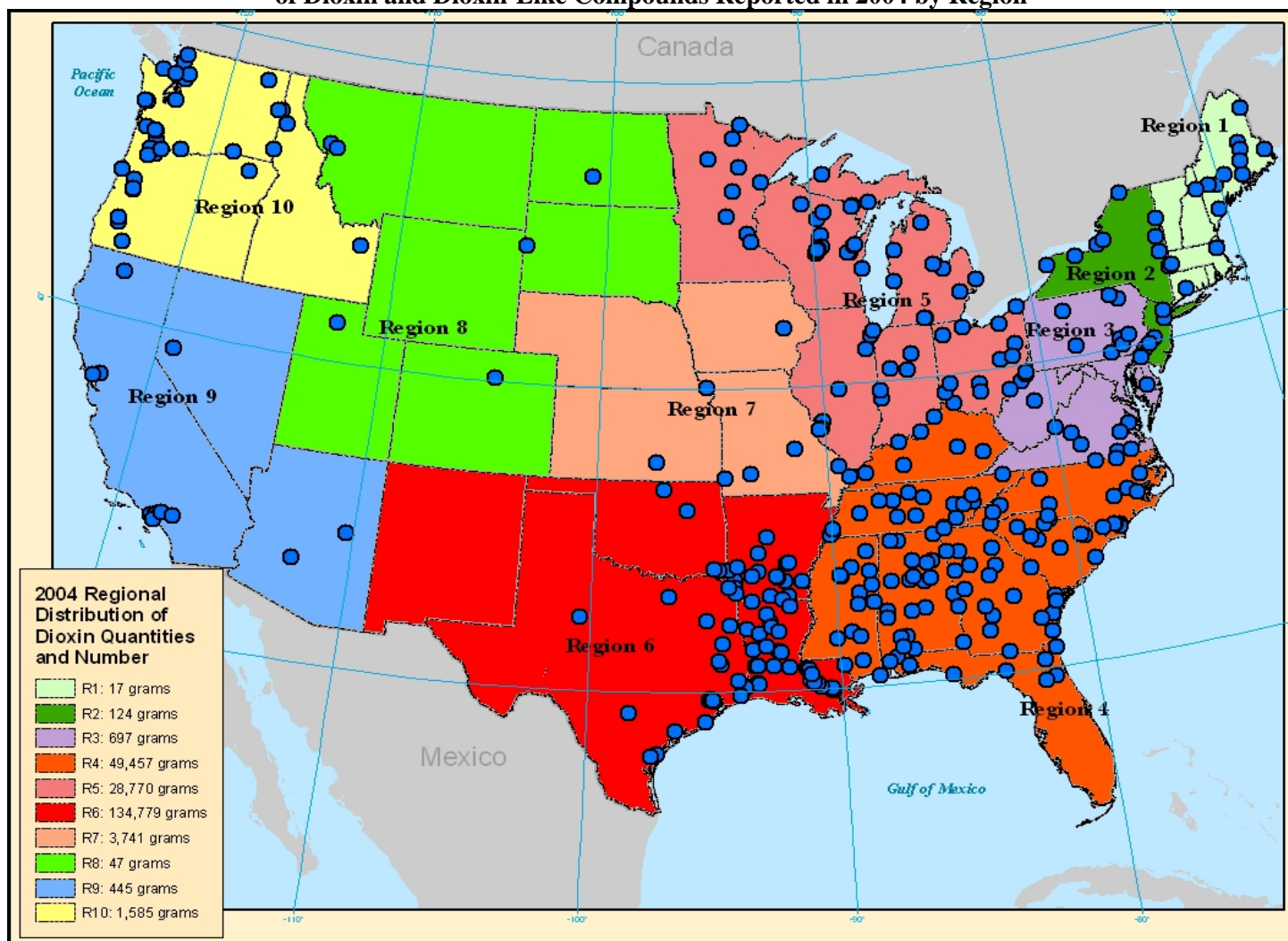


Exhibit 4.75 shows how dioxins were managed by facilities within each EPA region in 2004. Facilities in seven EPA regions used treatment as the primary method for managing their dioxins. Facilities in Region 5 used treatment and disposal for approximately equal portions of the dioxin quantity. Most of the dioxin reported by facilities in Region 7 was sent to offsite energy recovery. All of the dioxins reported by Region 8 facilities were sent to offsite disposal.

**Exhibit 4.75. Management Methods for Dioxin and Dioxin-Like Compounds, by EPA Region, 2004**

EPA Region	Quantity (grams) of Dioxins (2004)	Percent of Dioxins (2004)	Disposal (grams)		Energy Recovery (grams)		Treatment (grams)		Recycling (grams)	
			Onsite Disposal	Offsite Disposal	Onsite Energy Recovery	Offsite Energy Recovery	Onsite Treatment	Offsite Treatment	Onsite Recycling	Offsite Recycling
1	17	0.0%	1	2	0	0	13	0	0	1
2	124	0.1%	0	34	0	1	71	18	0	2
3	697	0.3%	5	251	7	0	429	5	0	0
4	49,457	22.5%	299	2,651	0	11,010	2,602	32,895	18	0
5	28,770	13.1%	13,602	677	0	13	14,252	226	0	0
6	134,779	61.4%	6,023	11,868	0	0	101,074	15,815	0	0
7	3,741	1.7%	444	168	0	3,057	0	72	0	0
8	47	0.0%	0	47	0	0	0	0	0	0
9	445	0.2%	0	126	0	1	45	272	0	0
10	1,585	0.7%	8	190	3	0	414	970	0	7

**State Trends:**

Although facilities in 42 states reported dioxins in 2004, Exhibits 4.76 through 4.79 only show the quantities for 2000–2004 for the five states in which facilities reported approximately 93 percent of the dioxins in 2004. Some highlights are:

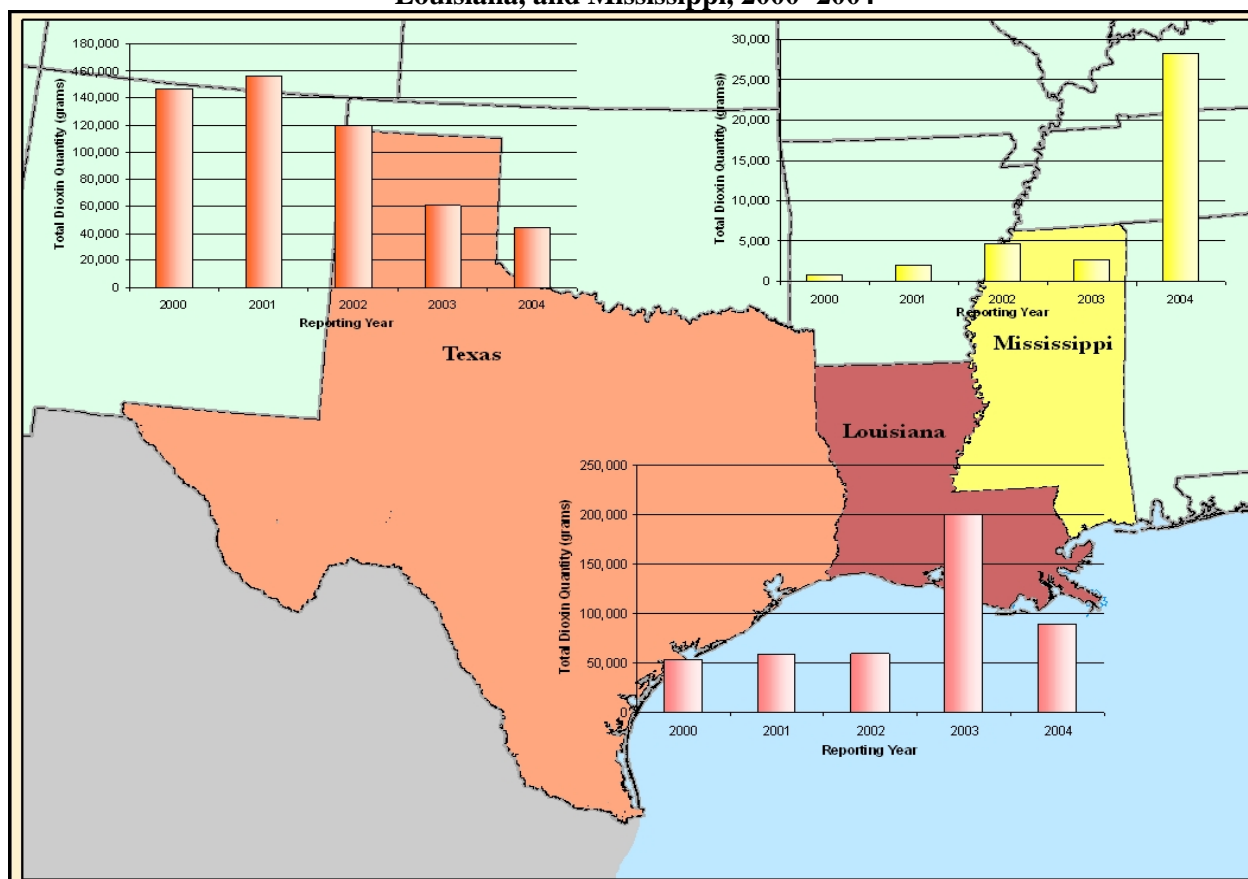
- Facilities in Louisiana reported approximately 41 percent of the total quantity of dioxins in 2004. This quantity is an increase of approximately 68 percent compared to the quantity for 2000, but is a 55 percent decrease from the quantity reported in 2003.
- Facilities in Texas reported 20 percent of the total dioxins quantity; since 2001 the quantity has steadily decreased each year.
- In 2004, facilities in Mississippi reported a large increase in dioxins, compared to quantities reported each year since 2000. Most of this increase was due to how a wood preserving facility in Mississippi estimated the concentration of dioxins in its wastes.
- Similarly, most of the increase reported by South Carolina facilities in 2004 was due to increased production and use of a different technique by a wood preserving facility for estimating the quantity of dioxins in wastes.

**Exhibit 4.76. State-Level Information for Dioxin and Dioxin-Like Compounds, 2000–2004**

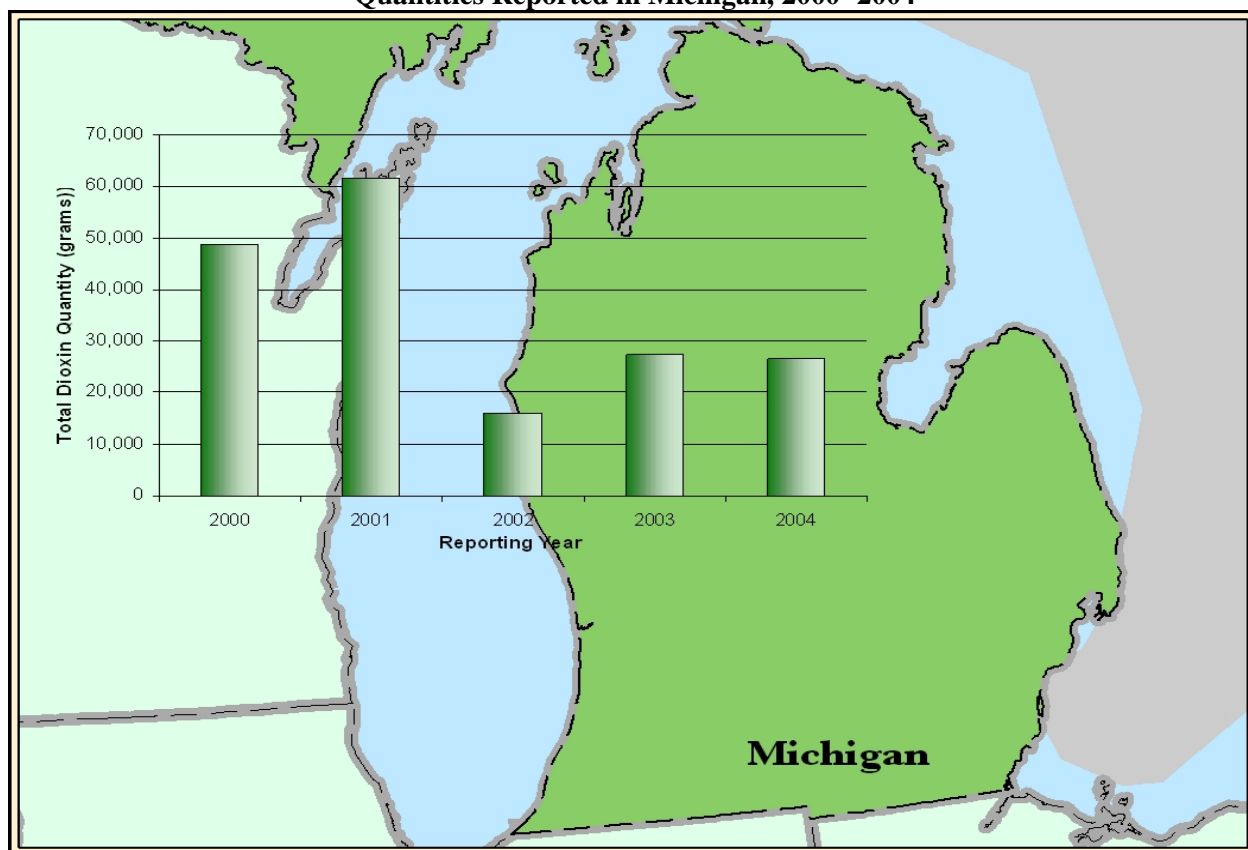
State	Total Quantity (grams) of Dioxins					Change in Quantity (2000–2004)	Percent Change in Quantity (2000–2004)	Percent of Total Quantity of This PC (2004)
	2000	2001	2002	2003	2004			
LA	53,573	58,352	59,556	200,406	89,823	36,250	67.7%	40.9%
TX	146,774	156,401	119,716	61,035	43,689	–103,084	–70.2%	19.9%
MS	748	2,010	4,719	2,770	28,221	27,473	3672.9%	12.8%
MI	48,814	61,741	16,149	27,387	26,627	–22,188	–45.5%	12.1%
SC	1,042	5,670	2,464	2,775	15,041	13,998	1343.0%	6.8%



**Exhibit 4.77. Trends in Dioxin and Dioxin-Like Compounds Quantities Reported in Texas, Louisiana, and Mississippi, 2000–2004**

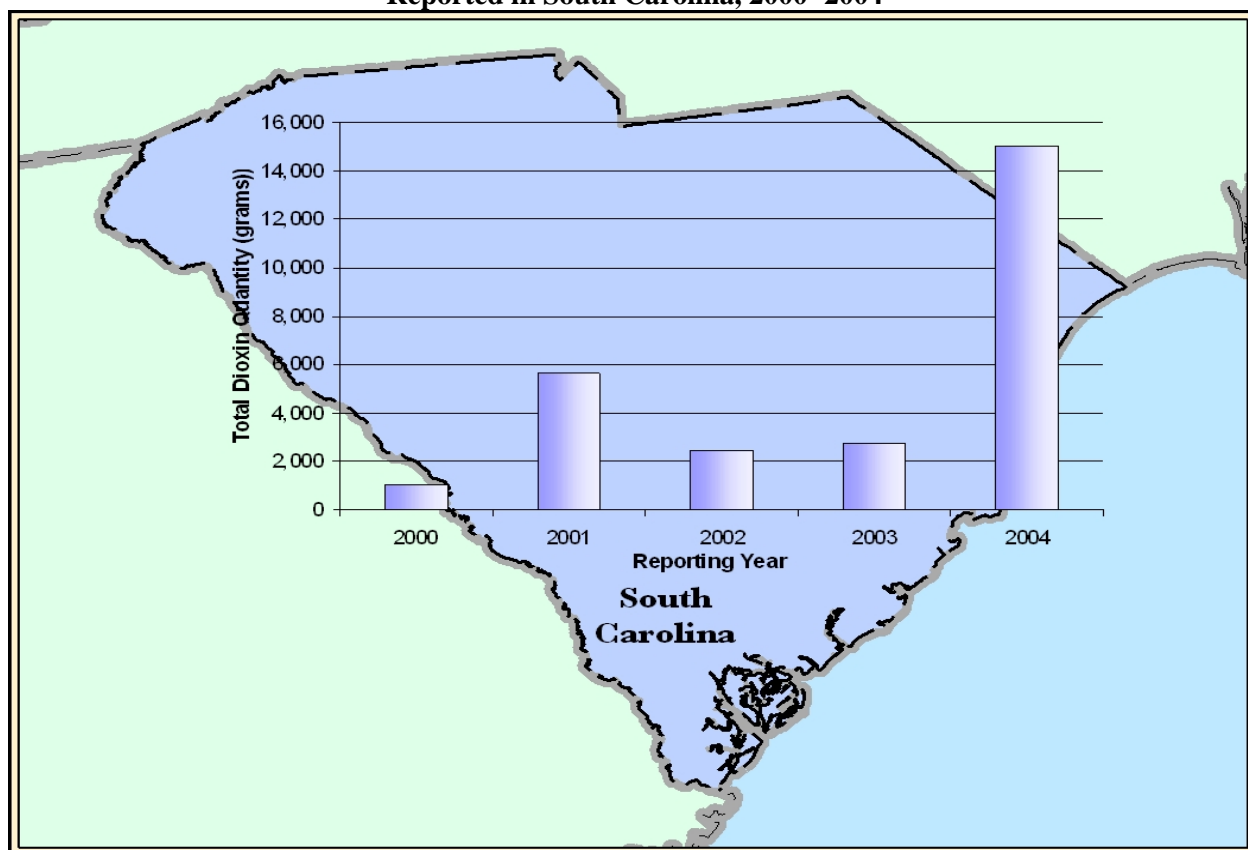


**Exhibit 4.78. Trends in Dioxin and Dioxin-Like Compounds Quantities Reported in Michigan, 2000–2004**





**Exhibit 4.79. Trends in Dioxin and Dioxin-Like Compounds Quantities  
Reported in South Carolina, 2000–2004**

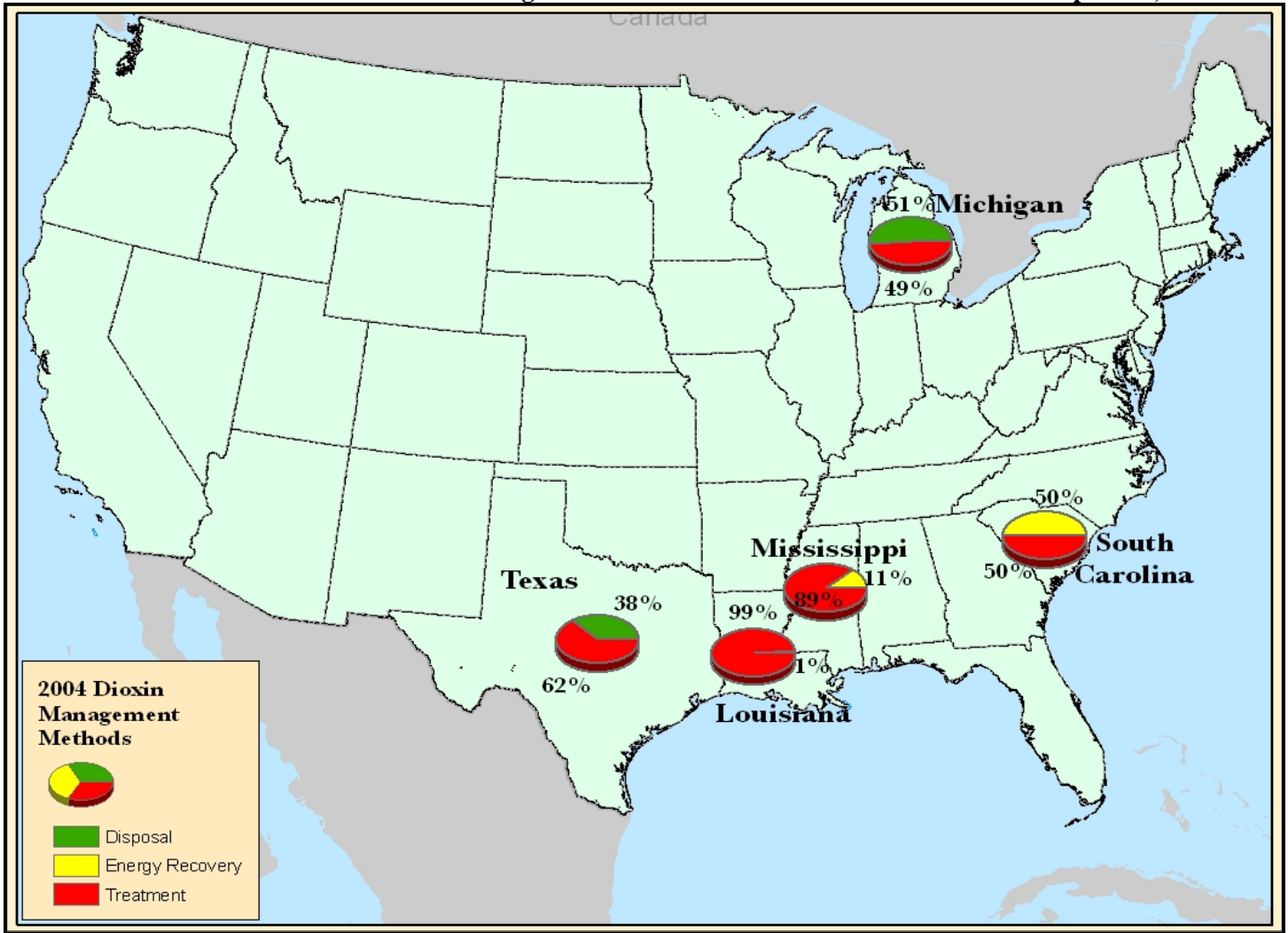


Exhibits 4.80 and 4.81 show how dioxins were managed by facilities in the five states where facilities reported approximately 93 percent of the total quantity of dioxins in 2004. These facilities treated most of the dioxins quantity. However, a significant portion of the dioxins in Texas and Michigan was sent to disposal. Facilities in South Carolina used energy recovery for approximately 50 percent of their dioxins.

**Exhibit 4.80. State Management Methods for Dioxin and Dioxin-Like Compounds  
(Facilities Reporting 93 Percent of Total Quantity) Based on Total 2004 Quantity**

State	Total Quantity (grams) of Dioxin (2004)	Onsite Disposal (grams)	Offsite Disposal (grams)	Onsite Energy Recovery (grams)	Offsite Energy Recovery (grams)	Onsite Treatment (grams)	Offsite Treatment (grams)	Onsite Recycling (grams)	Offsite Recycling (grams)
LA	89,823	43	896	0	0	84,168	4,717	0	0
TX	43,689	5,965	10,563	0	0	16,906	10,256	0	0
MI	28,221	4	5	0	3,211	13	24,987	0	0
MI	26,627	13,421	170	0	0	13,036	0	0	0
SC	15,041	11	0	0	7,524	36	7,470	0	0

**Exhibit 4.81. Distribution of State Management Methods for Dioxin and Dioxin-Like Compounds, 2004**



### Industry Sector (SIC) Trends:

Facilities in 39 industry sectors reported dioxins in 2004. Exhibit 4.82 shows the quantity of dioxins for the three industry sectors where facilities reported approximately 94 percent of the total quantity of dioxins in 2004. Facilities in SIC 2869 (Industrial organic chemicals, nec) reported approximately 55 percent of the total quantity of dioxins in 2004. For this industry sector, the quantity reported in 2004 was a significant increase from the quantities reported in 2000, as well as in 2003.

Facilities in SIC 2491 (Wood preserving) reported a large increase compared to the quantity reported in 2000, but had approximately a 66 percent decrease compared to the 2003 quantity. The large increase reported in 2003 and subsequent large decrease in 2004 was due to the quantity of dioxins reported by a wood preserving facility, in Louisiana. Facilities in SIC 2812 (Alkalies and chlorine) reported a decrease of approximately 77 percent compared to the quantity reported in 2000. In 2004, the quantity of dioxins reported by SIC 2812 facilities increased by approximately 73 percent compared to 2003.

**Exhibit 4.82. Industry Sectors Containing Dioxin and Dioxin-Like Compounds, 2000–2004**

Primary SIC	SIC Description	Number of Facilities in This Industry Sector That Reported Dioxins (2004)	2000 (grams)	2001 (grams)	2002 (grams)	2003 (grams)	2004 (grams)	Change in Quantity (2000– 2004)	Percent of Total Quantity of This PC (2004)
2869	Industrial organic chemicals, nec	18	37,971	94,745	83,475	95,647	120,049	82,077	54.7%
2491	Wood preserving	22	12,969	15,005	13,467	148,282	50,249	37,280	22.9%
2812	Alkalies and chlorine	13	151,865	159,301	16,519	20,540	35,550	–116,315	16.2%

Exhibit 4.83 shows how dioxins were managed by facilities in the three industry sectors that accounted for approximately 94 percent of the total quantity of dioxins in 2004. Treatment was the primary means of managing dioxins by facilities in all three of these industry sectors; approximately 79 percent of the dioxins were treated by these facilities in 2004. In 2004, facilities in both SIC 2869 and SIC 2812 land disposed approximately 17 percent of their dioxin quantities. Only facilities in SIC 2491 reported managing their dioxins using energy recovery.

**Exhibit 4.83. Management Methods for Dioxin and Dioxin-Like Compounds in Industry Sectors with 94 Percent of Total Quantity, 2004**

Primary SIC	SIC Description	Total Quantity (grams) of Dioxins (2004)	Percent of Total Quantity (2004)	Disposal (grams)		Energy Recovery (grams)		Treatment (grams)	
				Onsite Disposal	Offsite Disposal	Onsite Energy Recovery	Offsite Energy Recovery	Onsite Treatment	Offsite Treatment
2869	Industrial organic chemicals, nec	120,049	54.7%	13,454	8,233	0	0	87,006	11,356
2491	Wood preserving	50,249	22.9%	0	863	0	14,075	138	35,173
2812	Alkalies and chlorine	35,550	16.2%	6,405	144	0	0	25,539	3,462